# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

| | | |
|---|---|---|
| Applicant's or agent's file reference<br>AWP/70346WO00 | **FOR FURTHER ACTION** See Form PCT/IPEA/416 | |
| International application No.<br>PCT/GB2005/000120 | International filing date *(day/month/year)*<br>14.01.2005 | Priority date *(day/month/year)*<br>14.01.2004 |
| International Patent Classification (IPC) or national classification and IPC<br>INV. F02B37/007 F02B37/013 F01L9/02 F01L9/04 F02D13/02 F02B29/04 F02B37/04 F02B37/11 F02B39/10 F02B33/32 F02B37/18 F02B37/16 | | |
| Applicant<br>LOTUS CARS LIMITED et al. | | |

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 12 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 10 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in celectronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

| | | |
|---|---|---|
| ☒ | Box No. I | Basis of the report |
| ☐ | Box No. II | Priority |
| ☐ | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| ☒ | Box No. IV | Lack of unity of invention |
| ☒ | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| ☐ | Box No. VI | Certain documents cited |
| ☒ | Box No. VII | Certain defects in the international application |
| ☒ | Box No. VIII | Certain observations on the international application |

| | |
|---|---|
| Date of submission of the demand<br>03.11.2005 | Date of completion of this report<br>24.04.2006 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office - P.B. 5818 Patentlaan 2<br>NL-2280 HV Rijswijk - Pays Bas<br>Tel. +31 70 340 - 2040 Tx: 31 651 epo nl<br>Fax: +31 70 340 - 3016 | Authorized officer<br>Boye, M<br>Telephone No. +31 70 340-3864 |

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/GB2005/000120

## Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

| | |
|---|---|
| 1-14 | as originally filed |

**Claims, Numbers**

| | |
|---|---|
| 17-24 | as originally filed |
| 1-16 | received on 04.11.2005 with letter of 03.11.2005 |

**Drawings, Sheets**

| | |
|---|---|
| 1/6-6/6 | as originally filed |

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

## Box No. IV Lack of unity of invention

1. ☐ In response to the invitation to restrict or pay additional fees, the applicant has:
   - ☐ restricted the claims.
   - ☐ paid additional fees.
   - ☐ paid additional fees under protest.
   - ☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

   **see separate sheet**

4. Consequently, this report has been established in respect of the following parts of the international application:

   ☒ all parts.

   ☐ the parts relating to claims Nos. .

## Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 1-16 |
| | No: | Claims | |
| Inventive step (IS) | Yes: | Claims | 1-16 |
| | No: | Claims | |
| Industrial applicability (IA) | Yes: | Claims | 1-16 |
| | No: | Claims | |

2. Citations and explanations (Rule 70.7):

   **see separate sheet**

## Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

## Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

Reference is made to the following documents:

D1: WO 01/36797 A (FEV MOTORENTECHNIK GMBH; PISCHINGER, MARTIN; ESCH, THOMAS) 25 May 2001 (2001-05-25)
D2: EP-A-1 306 534 (HITACHI, LTD) 2 May 2003 (2003-05-02)
D3: US-B1-6 415 600 (LEJON SVANTE) 9 July 2002 (2002-07-09)
D4: US-A-6 029 452 (HALIMI ET AL) 29 February 2000 (2000-02-29)

**Re Item IV:**

This Authority considers that there are 4 inventions covered by the claims indicated as follows:

I: Claims 1-4,12-16 directed to a turbocharged internal combustion engine with two turbochargers arranged in series
II: Claims 5,6 directed to a turbocharged internal combustion engine with one turbocharger and one engine driven supercharger arranged downstream of the turbocharger compressor
III: Claim 7 directed to a turbocharged internal combustion engine with one turbocharger and one electrically driven compressor arranged upstream of the turbocharger compressor
IV: Claims 8-11 directed to the control of a turbocharged internal combustion engine having two turbochargers

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows, taking into account that general concepts like the compressing of air by two compressors in series cannot serve as a basis for a common inventive concept because this concept is part of the state of the art:

I) D1 discloses a turbocharged internal combustion engine with two separate exhaust ducts connected to two exhaust valves independently controlled by an electronic controller, one duct supplying exhaust to an exhaust turbocharger, the second duct

bypassing the exhaust turbocharger, supplying exhaust directly to a catalyst, the exhaust leaving the turbocharger also entering the catalyst.
It follows that the following technical features of claim 1 make a contribution over the prior art and can be considered as special technical features within the meaning of Rule 13.2 PCT:

Claim 1 of the application differs from D1 in that the second duct bypassing the first turbocharger supplies the exhaust to a second turbocharger, the second turbocharger driving a second compressor which delivers compressed air to the first compressor driven by the first turbocharger.
Although D2 discloses a first and second turbocharger, the compressors are not connected in series. Furthermore, there are neither two separately controllable exhaust valves disclosed nor two separate ducts connected to the respective exhaust valves.
The problem solved by this special technical feature can thus be construed as making use of the exhaust energy passing through the second duct to compress air while in D1, the bypassed exhaust is used to heat the catalyst.

The first invention thus meets the criteria of Article 33(1) PCT.

Dependant claims 2-4 as such also meet the requirements of the PCT with respect to novelty and inventive step.

Dependant claims 12-16 are directed to different independant claims thus putting the unity of invention of these claims into question. Dependant claims 12-16, if being exclusively dependant on claim 1, seem to meet the requirements of the PCT with respect to novelty and inventive step, too.

ii) The inventive concept of the second invention consists of compressing the air using also mechanical energy.
The special technical feature of the second invention consists of a supercharger mounted downstream of the compressor of the turbocharger.

iii) The inventive concept of the third invention consists of compressing the air using also electrical energy.

The special technical feature of the third invention consists of a electrically driven compressor mounted upstream of the compressor of the turbocharger.

iv) The inventive concept of the fourth invention consists of controlling two turbochargers. The special technical feature of the fourth invention consists of a controller controlling the actuators of the exhaust valves, thereby controlling what portion of the exhaust gases flows through the two separate ducts, the controller thereby controlling the operation of a first and second turbocharger.

In conclusion, the groups of claims are not linked by common or corresponding special technical features and define 4 different inventions not linked by a single general inventive concept.
The application, hence does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

**Re Item V:**

As discussed in Item IV, I) in detail, the first invention (claims 1-5) meets the criteria of Article 33(1) PCT.

Second invention (claims 5,6)

D3 discloses a turbocharged internal combustion engine (1) comprising a variable volume combustion chamber, inlet valve means controlling flow of air into the combustion chamber, fuel delivery means for delivering fuel into the air to be mixed therewith, exhaust valve means (2,3) for controlling flow of combusted gases from the combustion chamber, compressor means (14,15) for compressing the air prior to admission of the air into the combustion chamber, actuator means for opening and closing the exhaust valve means (2,3), and an electrical controller which controls operation of the actuator means to thereby control opening and closing of the exhaust valve means (2,3), wherein the exhaust valve means (2,3) comprises at least a first exhaust valve (2) connected to a first exhaust duct (4) and at least a second exhaust valve (3) connected to a second exhaust duct (5) separate and independant from the

first exhaust duct (4), the compressor means (14,15) comprises a turbocharger (14,15) and the first exhaust duct (4) is connected to the turbocharger (14,15) so that exhaust gases passing through the first exhaust duct (4) drive the turbocharger (14,15) to rotate, the second exhaust duct (5) bypasses the turbocharger (14,15) and the combusted gases flowing through the second exhaust duct (5) are exhausted without passing through the turbocharger, the electronic controller by controlling operation of the actuator means and thereby the opening and closing of the first and second exhaust valves (2,3) is operable to control what portion of the combustion gases leaving the combustion chamber flow through each of the first and second exhaust ducts (4,5).

The subject matter claimed in claim 5 differs from D3 in that the compressor means comprises additionally a supercharger, in that the turbocharger is a low pressure turbocharger which compresses intake air to a first pressure, in that the supercharger is a high pressure supercharger which compresses the compressed air output by the turbocharger to a second pressure higher than the first pressure, in that the compressor means comprises additionally a bypass passage through which compressed air compressed by the first turbocharger can bypass the supercharger and in that bypass valve means is provided to control flow of compressed air through the bypass passage.

The problem of the second invention consists of compressing the air using also mechanical energy.

The solution of the second invention consists of consists of a supercharger mounted downstream of the compressor of the turbocharger to compress the air further using also mechanical energy.

Although D3 discloses a turbocharged combustion engine with separated exhaust lines served with exhaust gases by separate exhaust valves and D2 (cf. claim 10) discloses a combination of a high pressure supercharger downstream of a low pressure compressor of a turbocharger, the combination of the engine of D3 with the additional mechanically driven high pressure supercharger of D2 would not be obvious for the technical expert because different problems are solved by D2,D3, namely controlling the turbocharger by controlling the exhaust valves in D3 and additional high pressure supercharging in D2.

Claim 5 of the present application does thus meet the criteria of Article 33(1) PCT, because the subject-matter of claim 5 is new in the sense of Article 33(2) PCT.

Claim 6, if dependant on claim 5 (see also VIII), does thus also meet the criteria of

Article 33(1) PCT.

Third invention (claim 7)

D3 discloses a turbocharged internal combustion engine (1) comprising a variable volume combustion chamber, inlet valve means controlling flow of air into the combustion chamber, fuel delivery means for delivering fuel into the air to be mixed therewith, exhaust valve means (2,3) for controlling flow of combusted gases from the combustion chamber, compressor means (14,15) for compressing the air prior to admission of the air into the combustion chamber, actuator means for opening and closing the exhaust valve means (2,3), and an electrical controller which controls operation of the actuator means to thereby control opening and closing of the exhaust valve means (2,3), wherein the exhaust valve means (2,3) comprises at least a first exhaust valve (2) connected to a first exhaust duct (4) and at least a second exhaust valve (3) connected to a second exhaust duct (5) separate and independant from the first exhaust duct (4), the compressor means (14,15) comprises a turbocharger (14,15) and the first exhaust duct (4) is connected to the turbocharger (14,15) so that exhaust gases passing through the first exhaust duct (4) drive the turbocharger (14,15) to rotate, the second exhaust duct (5) bypasses the turbocharger (14,15) and the combusted gases flowing through the second exhaust duct (5) are exhausted without passing through the turbocharger, the electronic controller by controlling operation of the actuator means and thereby the opening and closing of the first and second exhaust valves (2,3) is operable to control what portion of the combustion gases leaving the combustion chamber flow through each of the first and second exhaust ducts (4,5).

The subject matter claimed in claim 7 differs from D3 in that the compressor means comprises additionally an electrically driven compressor and the turbocharger is a high pressure turbocharger which receives compressed air compressed by the electrically driven compressor and pressurizes the air to a higher level, in that the compressor means comprises additionally a bypass passage through which air can bypass the electrically driven compressor to flow directly to the turbocharger, in that an electrically controlled bypass valve is provided to control flow of air through the bypass passage, and in that the controller controls operation of the bypass valve and the electrically-driven compressor such that the electrically driven compressor is operated only on starting the engine and/or at low engine speeds and otherwise intake air bypasses the

electrically driven compressor completely and is compressed only by the turbocharger.
The problem of the third invention consists of compressing the air using also electrical energy.
The solution of the third invention consists of an electrically driven compressor mounted upstream of the compressor of the turbocharger.
Although D3 discloses a turbocharged combustion engine with separated exhaust lines served with exhaust gases by separate exhaust valves and D4 discloses a combination of a low pressure electrically driven compressor upstream of a high pressure compressor of a turbocharger, the combination of the engine of D3 with the additional electrically driven low pressure compressor of D4 would not be obvious for the technical expert because different problems are solved by D3,D4, namely controlling the turbocharger by controlling the exhaust valves in D3 and additional low pressure supercharging in D4.
Claim 7 of the present application does thus meet the criteria of Article 33(1) PCT, because the subject-matter of claim 7 is new in the sense of Article 33(2) PCT.

Fourth invention (claims 8-11)

D3 discloses a turbocharged internal combustion engine (1) comprising a variable volume combustion chamber, inlet valve means controlling flow of air into the combustion chamber, fuel delivery means for delivering fuel into the air to be mixed therewith, exhaust valve means (2,3) for controlling flow of combusted gases from the combustion chamber, compressor means (14,15) for compressing the air prior to admission of the air into the combustion chamber, actuator means for opening and closing the exhaust valve means (2,3), and an electrical controller which controls operation of the actuator means to thereby control opening and closing of the exhaust valve means (2,3), wherein the exhaust valve means (2,3) comprises at least a first exhaust valve (2) connected to a first exhaust duct (4) and at least a second exhaust valve (3) connected to a second exhaust duct (5) separate and independant from the first exhaust duct (4), the compressor means (14,15) comprises a turbocharger (14,15) and the first exhaust duct (4) is connected to the turbocharger (14,15) so that exhaust gases passing through the first exhaust duct (4) drive the turbocharger (14,15) to rotate, the second exhaust duct (5) bypasses the turbocharger (14,15) and the combusted gases flowing through the second exhaust duct (5) are exhausted without passing through the turbocharger, the electronic controller by controlling operation of the actuator

means and thereby the opening and closing of the first and second exhaust valves (2,3) is operable to control what portion of the combustion gases leaving the combustion chamber flow through each of the first and second exhaust ducts (4,5).

The subject matter claimed in claim 8 differs from D3 in that the compressor means comprises additionally a second low pressure turbocharger which compresses air to a first pressure and the first turbocharger is a high pressure turbocharger which compresses air compressed by the low pressure turbocharger to a second pressure higher than the first pressure, in that the first exhaust duct relays exhaust gas to the first high pressure turbocharger to drive the high pressure turbocharger to rotate and the second exhaust duct relays exhaust gas to the second lower pressure turbocharger, bypassing the first high pressure turbocharger, to drive the second low pressure turbocharger to rotate and in that the controller controls operation of the actuator means to control what proportion of combusted gases flowing from the combustion chamber flow through the first exhaust duct and what proportion flow through the second exhaust duct, the controller thereby controlling operation of the first high pressure and the second low pressure turbochargers.

The problem of the fourth invention consists of controlling two turbochargers.

The solution of the fourth invention consists of a controller controlling the actuators of the exhaust valves, thereby controlling what portion of the exhaust gases flows through the two separate ducts, the controller thereby controlling the operation of a first and second turbocharger.

Claim 8 of the present application does thus meet the criteria of Article 33(1) PCT, because the subject-matter of claim 8 is new in the sense of Article 33(2) PCT. Dependant claims 9-11 are directed to advantageous embodiments of the subject matter of claim 8 and are thus also considered novel and inventive.

**Re Item VII.**

Independent claims 1,5,7,8 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

**Re Item VIII:**

Independant claims 5,7 refer to a " compressor means comprising a first turbocharger" while the subject matter of claims 5,7 does not comprise a second turbocharger but a second compressor, resulting in lack of clarity (Article 6 PCT).

Claim 8 comprises all the features of claim 1 and is therefore not appropriately formulated as a claim dependent on the latter (Rule 6.4 PCT), thus resulting in lack of clarity of the application (Article 6 PCT).

Claim 6 is unclear (Article 6 PCT) insofar as it is dependant on claim 11. Claim 6 must refer to claim 5.

Claims 12-16 are unclear (Article 6 PCT) insofar as they refer to a multiple independent claims.

CLAIMS

1. A turbocharged internal combustion engine comprising:

a variable volume combustion chamber;

inlet valve means controlling flow of air into the combustion chamber;

fuel delivery means for delivering fuel into the air to be mixed therewith;

exhaust valve means for controlling flow of combusted gases from the combustion chamber;

compressor means for compressing the air prior to admission of the air into the combustion chamber;

actuator means for opening and closing the exhaust valve means; and

an electronic controller which controls operation of the actuator means to thereby control opening and closing of the exhaust valve means, wherein:

the exhaust valve means comprises at least a first exhaust valve connected to a first exhaust duct and at least a second exhaust valve connected to a second exhaust duct separate and independent from the first exhaust duct;

the compressor means comprises a first turbocharger and the first exhaust duct is connected to the first turbocharger so that exhaust gases passing through the first exhaust duct drive the first turbocharger to rotate;

the second exhaust duct bypasses the first turbocharger and the combusted gases flowing through the second exhaust duct are exhausted without passing through the first turbocharger; and

the electronic controller by controlling operation of the actuator means and thereby the opening and closing of

the first and second exhaust valves is operable to control what proportion of the combusted gases leaving the combustion chamber flow through each of the first and second exhaust ducts;

the compressor means comprises additionally a second turbocharger;

the first turbocharger is a high pressure turbocharger which can receive compressed air at a first pressure from the second turbocharger, which is a low pressure turbocharger, and the first turbocharger compresses the air to a second higher pressure; and

combusted gases leaving the first turbocharger after expansion in a turbine thereof are combined with the combusted gases flowing in the second exhaust duct and then the combined flow of combusted gases drive the second turbocharger to rotate.

2. A turbocharged internal combustion engine as claimed in claim 1 wherein combusted gases leaving the second turbocharger flow through a catalytic converter and then to atmosphere.

3. A turbocharged internal combustion engine as claimed in claim 1 or claim 2 comprising additionally a first intercooler through which air compressed in the second low pressure turbocharger passes before reaching the first high pressure turbocharger.

4. A turbocharged internal combustion engine as claimed in any one of claims 1 to 3 comprising additionally an intake air bypass passage through which air compressed by

the second turbocharger can flow to the intake valve means bypassing the first turbocharger and bypass valve means controlling flow of the compressed air through the bypass passage.

5. A turbocharged internal combustion engine comprising:

a variable volume combustion chamber;

inlet valve means controlling flow of air into the combustion chamber;

fuel delivery means for delivering fuel into the air to be mixed therewith;

exhaust valve means for controlling flow of combusted gases from the combustion chamber;

compressor means for compressing the air prior to admission of the air into the combustion chamber;

actuator means for opening and closing the exhaust valve means; and

an electronic controller which controls operation of the actuator means to thereby control opening and closing of the exhaust valve means, wherein:

the exhaust valve means comprises at least a first exhaust valve connected to a first exhaust duct and at least a second exhaust valve connected to a second exhaust duct separate and independent from the first exhaust duct;

the compressor means comprises a first turbocharger and the first exhaust duct is connected to the first turbocharger so that exhaust gases passing through the first exhaust duct drive the first turbocharger to rotate;

the second exhaust duct bypasses the first turbocharger and the combusted gases flowing through the second exhaust duct are exhausted without passing through the first turbocharger;

the electronic controller by controlling operation of the actuator means and thereby the opening and closing of the first and second exhaust valves is operable to control what proportion of the combusted gases leaving the combustion chamber flow through each of the first and second exhaust ducts;

the compressor means comprises additionally a supercharger;

the first turbocharger is a low pressure turbocharger which compresses intake air to a first pressure;

the supercharger is a high pressure supercharger which compresses the compressed air output by the first turbocharger to a second pressure higher than the first pressure;

the compressor means comprises additionally a bypass passage through which compressed air compressed by the first turbocharger can bypass the supercharger; and

bypass valve means is provided to control flow of compressed air through the bypass passage.

6. A turbocharged internal combustion engine as claimed in Claim 11 wherein the bypass valve is an electrically-controlled valve controlled by the electronic controller.

7. A turbocharged internal combustion engine comprising:

a variable volume combustion chamber;

inlet valve means controlling flow of air into the combustion chamber;

fuel delivery means for delivering fuel into the air to be mixed therewith;

exhaust valve means for controlling flow of combusted gases from the combustion chamber;

compressor means for compressing the air prior to admission of the air into the combustion chamber;

actuator means for opening and closing the exhaust valve means; and

an electronic controller which controls operation of the actuator means to thereby control opening and closing of the exhaust valve means, wherein:

the exhaust valve means comprises at least a first exhaust valve connected to a first exhaust duct and at least a second exhaust valve connected to a second exhaust duct separate and independent from the first exhaust duct;

the compressor means comprises a first turbocharger and the first exhaust duct is connected to the first turbocharger so that exhaust gases passing through the first exhaust duct drive the first turbocharger to rotate;

the second exhaust duct bypasses the first turbocharger and the combusted gases flowing through the second exhaust duct are exhausted without passing through the first turbocharger;

the electronic controller by controlling operation of the actuator means and thereby the opening and closing of the first and second exhaust valves is operable to control what proportion of the combusted gases leaving the combustion chamber flow through each of the first and second exhaust ducts;

the compressor means comprises additionally an electrically-driven compressor and the first turbocharger is a high pressure turbocharger which receives compressed air compressed by the electrically-driven compressor and pressurises the air to a higher level;

the compressor means comprises additionally a bypass passage through which air can bypass the electrically-driven compressor to flow directly to the turbocharger;

an electrically-controlled bypass valve is provided to control flow of air through the bypass passage; and

the controller controls operation of the bypass valve and the electrically-driven compressor such that the electrically-driven compressor is operated only on starting the engine and/or at low engine speeds and otherwise intake air bypasses the electrically-driven compressor completely and is compressed only by the turbocharger.

8. A turbocharged internal combustion engine comprising:

a variable volume combustion chamber;

inlet valve means controlling flow of air into the combustion chamber;

fuel delivery means for delivering fuel into the air to be mixed therewith;

exhaust valve means for controlling flow of combusted gases from the combustion chamber;

compressor means for compressing the air prior to admission of the air into the combustion chamber;

actuator means for opening and closing the exhaust valve means; and

an electronic controller which controls operation of the actuator means to thereby control opening and closing of the exhaust valve means, wherein:

the exhaust valve means comprises at least a first exhaust valve connected to a first exhaust duct and at least a second exhaust valve connected to a second exhaust duct separate and independent from the first exhaust duct;

the compressor means comprises a first turbocharger and the first exhaust duct is connected to the first turbocharger so that exhaust gases passing through the first exhaust duct drive the first turbocharger to rotate;

the second exhaust duct bypasses the first turbocharger and the combusted gases flowing through the second exhaust duct are exhausted without passing through the first turbocharger;

the electronic controller by controlling operation of the actuator means and thereby the opening and closing of the first and second exhaust valves is operable to control what proportion of the combusted gases leaving the combustion chamber flow through each of the first and second exhaust ducts;

the compressor means comprises a second low pressure turbocharger which compresses air to a first pressure and the first turbocharger is a high pressure turbocharger which compresses air compressed by the low pressure turbocharger to a second pressure higher than the first pressure;

the first exhaust duct relays exhaust gas to the first high pressure turbocharger to drive the high pressure turbocharger to rotate and the second exhaust duct relays exhaust gas to the second lower pressure turbocharger, bypassing the first high pressure turbocharger, to drive the second low pressure turbocharger to rotate; and

the controller controls operation of the actuator means to control what proportion of combusted gases flowing from the combustion chamber flow through the first exhaust duct and what proportion flow through the second exhaust duct, the controller thereby controlling operation

of the first high pressure and the second low pressure turbochargers.

9. A turbocharged internal combustion engine as claimed in claim 8 wherein the expanded exhaust gases leaving the first high pressure turbocharger are fed into the second exhaust duct to be relayed to the second low pressure turbocharger.

10. A turbocharged internal combustion engine as claimed in claim 8 or claim 9 wherein the compressor means comprises additionally a bypass passage through which air can bypass the first high pressure turbocharger and a bypass valve controlling flow of air through the bypass passage.

11. A turbocharged internal combustion engine as claimed in claim 10 wherein the bypass valve is controlled by the electronic controller.

12. A turbocharged internal combustion engine as claimed in any one of claims 5 to 11, wherein the compressor means comprises additionally an intercooler for cooling the compressor intake air prior to delivery of the air into the combustion chamber.

13. A turbocharged internal combustion engine as claimed in one of claims 1 to 12, which comprises additionally a starting valve controlled by the electronic controller which can prevent flow of exhaust gases through the second exhaust duct during engine starting and wherein:

exhaust gases leaving the turbocharger supplied by the first exhaust duct are fed into the second exhaust duct upstream of the starting valve; and

the electronic controller during starting of the engine operates to close the starting valve and to open and close the exhaust valve means so that compressed gases leaving the combustion chamber are relayed via the first exhaust duct to the first turbocharger connected thereto to drive the said first turbocharger and then are returned to the combustion chamber via the second exhaust duct to be compressed again in the combustion chamber.

14. A turbocharged internal combustion engine as claimed in any one of claims 1 to 12 comprising additionally a storage tank, a storage tank passage leading from the combustion chamber to the storage tank and cylinder head storage tank valve means controlling flow of combusted gases to the storage tank from the combustion chamber and also flow of stored combusted gases from the storage tank to the combustion chamber, whereby combusted gases compressed in the combustion chamber can be relayed to the storage tank for storage therein and for later return to the cylinder for expansion therein.

15. A turbocharged internal combustion engine as claimed in any one of the preceding claims wherein the injector means can inject fuel into the combustion chamber early enough in an upstroke for mixing of the fuel with air to produce a homogeneous mixture which is then ignited by homogeneous charge compression ignition and wherein the injection means can alternatively inject fuel later in the

upstroke for compression ignition in the combustion chamber.

16. A turbocharged internal combustion engine as claimed in claim 15 wherein in part load operating conditions of the engine the controller operates to close the exhaust valve means during the upstroke of the piston in order to

trap combusted gases in the combustion chamber, the trapped combusted gases forming a mixture with the fuel and air and serving to delay ignition of the fuel and air mixture when the engine is operating with homogeneous charge compression ignition.